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Goat Population Number Simulation and Breeding Parameter Estimation at UPTD BPPTDK, Yogyakarta

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ABSTRACT

Goats farming plays a vital role in ensuring food security and boosting rural incomes, especially in Yogyakarta Special Region. Saanen, Sapera, and Bligon goats are important breeds because of their significant economic value in both meat and milk production. For sustainable development, precise estimates of population trends, breeding factors, and income are essential for effective management and policy formulation. This study aims to estimate the population number of goats, breeding parameters, and gross income over the next five years. The research was conducted from July to September 2024 at The Regional Technical Implementation Unit of the Animal Diagnostic Livestock Breeding Development Center (UPTD BPPTDK) under the Department of Agriculture and Food Security, Special Region of Yogyakarta. The data collected includes both primary and secondary data. Primary data was obtained through direct interviews with staff and management at UPTD BPPTDK-DPKP of the Special Region of Yogyakarta. In contrast, secondary data comprised the latest 2024 population statistics obtained from UPTD BPPTDK. This data served as the basis for simulating population growth and calculating breeding parameters for the next five years. Based on the simulation results, the population of Saanen goats increased, with the percentage increase in livestock population from 2024 to 2028 reaching 125% for Saanen goats, 105% for Sapera goats, and 122% for Bligon goats. The average natural increase (NI) over five years was 40.70% for Saanen goats, 43.93% for Sapera goats, and 44.52% for Bligon goats. The net replacement rate (NRR) for male Saanen goats was 319.2% and for females 211.80%; for male Sapera goats, 453.51% and females 208.92%; for male Bligon goats 517.01% and females 209.68%. The total output, or number of goats that can be sold over five years, was 399, 138, and 432 for Saanen, Sapera, and Bligon goats, respectively. The gross income over five years was IDR 2,738,350,000. Based on these results, proper livestock management at UPTD BPPTDK-DPKP DIY can lead to increased and balanced goat populations over the next five years. These estimations can be used to inform policy decisions for livestock development programs at UPTD BPPTDK-DPKP DIY.

Keywords: *Goats, Population Growth Simulation, Breeding Parameter, Regional Revenue*

Introduction

Goats are small ruminants that are currently widely developed in various regions in Indonesia. According to Kurinasari et al. (2013), goats have high adaptability to various environmental conditions, so their population is evenly distributed, especially in rural areas. Data shows that the goat population in Central Java in 2019 is about 4,084,301, 147,288 higher than in 2018. (BPS, 2021). In the Special Region of Yogyakarta, the goat population November 2024 was 426,973, about of 3% higher than 2023(DIY Agriculture and Food Security Office, 2024). The Regional Technical Implementation Unit (UPTD) of the Animal Diagnostic Livestock Breeding Development Center (BPPTDK) under the auspices of the Yogyakarta Special Region (DIY) Agriculture and Food Security Office has a strategic role in supporting the livestock sector, especially in providing superior goat breeds of Saanen, Sapera, and Bligon. The selection of UPTD BPPTDK DIY as the object of research is based on the great potential it has in producing quality breeds, both as replacement stock and marketable commodities.

This study offers a unique and original contribution by integrating existing field data with population simulations to forecast the dynamics of

goats population, breeding parameters, and potential gross income for Saanen, Sapera, Bligon goats over a span of five years. In contrast to earlier research that concentrated only on population and breeding parameters, this study combines demographic and economic estimates, providing useful insights for livestock management and policy formulation. Livestock population growth simulation is a method to project changes in population size based on technical factors such as birth, selection, and mortality rates. Meanwhile, breeding parameters are indicators used to evaluate the success of a breeding system. These parameters can be calculated through the natural increase (NI) value, net replacement rate (NRR), and output. NI shows the difference between birth and death rates in a certain period and is an indicator of successful parent management (Sumadi, 2001). NRR measures the ability of an area to produce replacement livestock; values over 100% indicate surplus and potential as a source of breeding stock, while values below 100% indicate potential population decline (Hardjosubroto, 1994). Output reflects the ability of the region to sell the livestock without disturbing the population balance. Until now, UPTD BPPTDK DIY, as a goat breeding institution, has never estimated population growth or analyzed breeding parameters from its population. In addition, the estimation of gross income from breedstock production activities has also not been carried out. Therefore, studies on population growth simulation, calculation of breeding parameters, and estimation of gross income in goats are important and critical to be carried out as a basis for planning and policy-making for livestock growth in UPTD BPPTDK DIY.

Materials and Methods

Materials

The materials used in this research include data and supporting equipment. The data used consisted of primary and secondary data. Primary data were obtained from interviews with officers and leaders of the UPTD BPPTDK of the Agriculture and Food Security Office of Yogyakarta Special Region regarding the general conditions, livestock status, and maintenance management system. Secondary data included population and performance records of Saanen, Sapera, and Bligon goats, which were used for population growth estimation analysis based on breeding parameters (NI, NRR, and Output) and livestock price data obtained from local regulations and interviews. The equipment used in this study included digital cameras, stationery, laptops, and questionnaires.

Methods

Primary data collection was conducted through direct interviews with staff and leaders of the UPTD BPPTDK of the Agriculture and Food Security Office of Yogyakarta Special Region using a structured questionnaire guide. Secondary data collected included information on the population of Saanen, Sapera, and Bligon goats, including data on births, deaths, and livestock migration obtained from the official records of the UPTD BPPTDK of the Agriculture and Food Security Office of Yogyakarta Special Region and calculating the number of livestock at the latest location according to livestock breed.

In addition, due to the limited availability of field data particularly because the three goat breeds are relatively new livestock commodities at the research site, technical parameters such as length of rearing period, birth and mortality rates, selection percentages at weaning and one year of age, number of offspring, sex ratio, and age-specific selection rates were estimated based on relevant literature and established theoretical models.

Data Analysis

The primary, secondary, and technical coefficient data obtained will be used to calculate breeding parameters (natural increase value, NRR, output) and population growth simulation models.

Simulation of Population Growth Model Formulas (%)

a. Birth Rate = 150% × Number of Parents
   Male Births
   50% × Birth Rate
   Female Births
   50% x Birth rate
b. Mortality Rate (birth to weaning) = 5% × Birth rate
   Male mortality (birth-weaning)
   50% × Male Mortality rate
   Female mortality (birth-weaning)
   50 % × Female Mortality rate
c. Number of selected (Weaning period)
   Male
   50 % × (Male births − Male deaths)
   Female
   90 % × (Female births − Female deaths)
d. Output at Weaning
   Male
   Males Births – Mortality Rate (Birth to Weaning) – Number of Selected Male
   Female
   Female births– Mortality Rate (Birth to Weaning) – Number Of Selected Females
e. Mortality rate (weaning to 6 Months) = 2% x Birth Rate
   Male
   2% × Males Birth Rate
   Female
   2% × Females Birth Rate
f. Number of Selected (6 Months)
   Male
   50 % × (Male Number Selected Weaning Period − Male Mortality Rate Weaning to 6 Months)
   Female

90% × (Male Number Selected Weaning Period − Male Mortality Rate Weaning to 6 Months)

g. Output at 6 Months
Male
(Male Number of selected Weaning period - Male Mortality rate weaning to 6 Months)- Male Number of Selected 6 Months
Female
(Female Number of selected Weaning period - Female Mortality rate weaning to 6 Months)- Female Number of Selected 6 Months

h. Number of Selected (12 Months)
Male
100% x Male Number of Selected 6 Months
Female
100% x Female Number of Selected 6 Months

i. Number of Replacement

$$\text{Male} = \frac{\text{Number of Initial Population}}{4}$$

$$\text{Female} = \frac{\text{Number of Initial Population}}{4}$$

j. Output at 12 Months
Male
Male Number of Selected 12 Months – Male Number of Replacement
Female
Female Number of Selected 12 Months – Female Number of Replacement

k. Total Output
Output at Weaning + Output at 6 Months + Output at 12 Months

l. Final Population
Initial Male Population + Initial Female Population + Young Male + Young Female

Breeding Parameters Formulas (Sumadi et al., 2001)

a. Natural Increase

$$\text{Birth Rate (\%)} = \frac{\text{Total births per year}}{\text{total population}} \text{ x } 100\%$$

$$\text{Mortality Rate (\%)} = \frac{\text{Total deaths per year}}{\text{Total population}} \text{ x } 100\%$$

Natural Increase (%) = Birth rate − Mortality rate

b. Net Replacement Rate

$$\text{Male Replacement Need (\%)} = \frac{\text{Number of adult males}}{\text{years of sire use}} \text{ x } 100\%$$

$$\text{Female Replacement Need (\%)} = \frac{\text{Number of adult females}}{\text{years of sire use}} \text{ x } 100\%$$

$$\text{Male Natural Increase (\%)} = \frac{\text{Number of male calves}}{\text{Total population}} \text{ x } 100\%$$

$$\text{Female Natural Increase (\%)} = \frac{\text{Number of female calves}}{\text{Total population}} \text{ x } 100\%$$

$$\text{Net Replacement Rate for Males (\%)} = \frac{\text{Male Natural Increase}}{\text{Male Replacement Need}} \text{ x } 100\%$$

$$\text{Net Replacement Rate for Females (\%)} = \frac{\text{Female Natural Increase}}{\text{Female Replacement Need}} \text{ x } 100\%$$

c. Output
Surplus male replacements (%)
Male Natural Increase − Male Replacement Need
Surplus female replacements (%)
Female Natural Increase − Female Replacement Need
Culled male stock (%)
Male Replacement Need
Culled female stock (%)
Female Replacement Need
Total output (%)
Surplus male + Surplus female + Culled males + Culled females
Estimated Livestock Sales
(Number of Weaning Periods x Livestock Price Weaning Period) + (Number of 6 Months x Livestock Price at 6 Months) + (Number of 12 Months x Livestock Proce at 12 Months)

Results and Discussion

Simulation Population Growth

Simulation of population growth in this study was conducted using several technical coefficients, namely the percentage of births, deaths, and livestock selection rates that will be issued as output. The birth percentage used in this simulation is 150% (Muchtar *et al*, 2012). This reflects the prolific nature of goats, which is the ability of a female mother to give birth to more than one kid in one birth. This prolific nature is generally more prominent in the second, third, and subsequent births. Wati and Saili (2014) stated that goats have the potential to give birth to more than one kid, and this is supported by Hidayat *et al*. (2019), who explained that prolificacy is the ability of a mother to produce more than one kid in each birth. In terms of mortality, this simulation considers two phases of livestock growth. The first phase occurs from birth to weaning age, with a mortality rate of 5%. The second phase occurs from weaning to one year, with a mortality rate of 2%. According to Nasution et al. (2014), the highest mortality rate occurs in newborn goat kids, which is generally caused by factors such as hypothermia, lack of nutrition, dystocia, and disease.

Based on the simulation results, the population of Saanen, Sapera, and Bligon goats showed an increasing trend from year to year from 2024 to 2028. The percentage increase in male and female population during the period was recorded at 125% for Saanen goats, 105% for Sapera goats, and 122% for Bligon goats, as shown in Table 1. This population growth reflects the significant growth potential of these three goat breed in the study area. To design a sustainable growth strategy, it is important to understand the potential for livestock population growth over time. Estimating population growth per unit of time provides important information on the direction and rate of population change, which is very useful in

production planning and maintenance management. This is in line with the opinion of Willy *et al*. (2022), who stated that an understanding of the structure of the livestock population is needed to provide a comprehensive picture of the population balance, including the context of regeneration and sustainability of the goat population.

Table 1. Result Simulation Population Growth

Breeds	Year	Sex	Start of Year Population	Births (150%)	Weaning			6 Months			12 Months			Final Population (*******)
					Deaths (5%)	Selection (*)	Out (**)	Death (2%)	Selection (***)	Out (****)	Selection (100%)	*Re-placement* (*****)	Out (******)	
Saanen	2024	M	**21**	23	1	11	11	0	6	6	6	5	1	26
		F	**31**	24	1	21	2	1	18	2	18	8	10	39
	2025	M	26	29	1	14	13	0	7	7	7	5	2	31
		F	39	29	1	25	3	0	22	2	22	8	14	47
	2026	M	31	35	1	17	17	0	8	8	8	5	3	36
		F	47	35	2	30	3	1	26	3	26	8	18	55
	2027	M	36	41	2	20	20	0	10	10	10	5	5	41
		F	55	41	2	35	4	1	31	4	31	8	23	63
	2028	M	41	47	3	22	22	0	11	11	11	5	6	**46**
		F	63	47	3	40	4	1	35	4	35	8	27	**71**
Sapera	2024	M	**7**	10	0	5	5	0	2	2	2	1	1	8
		F	**13**	10	1	8	1	1	6	1	6	3	3	16
	2025	M	8	12	1	6	5	0	3	3	3	1	2	9
		F	16	12	1	10	1	0	9	1	9	3	6	19
	2026	M	19	15	0	7	7	0	4	4	4	1	3	10
		F	20	15	1	13	1	0	11	1	11	3	7	23
	2027	M	10	17	0	9	9	0	4	4	4	1	3	11
		F	23	17	1	15	2	0	13	1	13	3	10	26
	2028	M	11	20	1	9	9	0	4	5	4	1	3	**12**
		F	26	19	1	16	2	0	14	1	14	3	11	**29**
Bligon	2024	M	**17**	31	2	15	15	0	7	7	7	4	3	21
		F	**41**	31	2	27	3	1	23	3	23	10	13	51
	2025	M	21	38	2	18	18	0	9	9	9	4	5	25
		F	51	38	2	33	4	1	29	3	29	10	19	62
	2026	M	25	46	2	22	22	0	11	11	11	4	7	29
		F	62	46	2	39	4	1	34	4	34	10	23	72
	2027	M	29	54	2	26	26	0	13	13	13	4	9	33
		F	72	54	3	46	5	1	41	5	41	10	30	82
	2028	M	33	62	4	29	29	1	14	15	14	4	10	**37**
		F	82	61	4	51	6	1	45	5	45	10	35	**92**

*Male goats selected at weaning 50% of (number of male births-number of deaths from birth to weaning). Female goats selected at weaning 90% of (number of female births-number of deaths from birth to weaning).
**Output goats during the weaning period is calculated as (number of animals born-number of animals that die from birth to weaning-number of animals selected at weaning.
*** Male goats selected at 6 months 50% of (number of males selected at weaning-number of deaths from weaning to 6 months). Female goats selected at weaning 90% of (number of female births-number of deaths from birth to weaning).
****Goats exiting during the weaning period is calculated as (number of animals born-number of animals that die from birth to weaning-number of animals selected at weaning).
***** The number of male goats replacement is calculated by the initial population of male goats/ 4. The number of female goats replacement is calculated by the initial population of female goats/ 4.
****** Goat livestock outputs for a 12-month period are obtained from (number of selected livestock for a 12-month period - number of replacement livestock).
*******The year-end population of male livestock is obtained from the initial male population + the number of male replacement livestock. The year-end population of females is obtained from the year-end population of males + the number of replacement females.

The growth of livestock populations is strongly influenced by the dynamics between the increase and expenditure of livestock, either through sale, slaughter, or death. In other words, the balance between birth, death, and selection determines the rate of population increase. Population increase can be achieved through two approaches, namely increasing productivity per head of livestock and managing livestock expenditure adjusted to population growth capacity (Poerwoto & Dania, 2006). The population growth of Saanen, Sapera, and Bligon goats, which shows a positive trend in the next five years, is highly dependent on of good and sustainable maintenance management.

Breeding Parameter

Natural Increase

The natural increase is obtained by reducing the birth rate by the death rate in a certain area and a certain time, which is usually measured on an annual basis (Guntoro et al., 2023). The results of the analysis of the calculation of the Natural Increase population (Table 2) show that the average NI for five years is 40.70% for Saanen goats, 43.93% for Sapera goats, and 44.52% Bligon goats. Based on these results. Kusuma et al. (2017) stated that the highest NI can be obtained if all mothers in the population give birth and there is no death of calves. Determination of the NI category is done by looking at the percentage of the parent population to the population, from the percentage, then divided by three so that the results of low, medium, and high categories are 0-10.24; 10.24-20.48; 20.48-30.73, respectively.

NI in this study for the three goats studied can be classified into the high category because the value exceeds the specified category and has a birth rate higher than the mortality rate of the three goat breeds (Table 2). Oktafiana et al. (2021) stated that a high NI category can be achieved with adequate availability of productive livestock, high birth rates, and low mortality rates. This can happen because goats can give birth to more than one kid. Sumadi et al. (2004) states that the NI can reach a maximum if the percentage of births to the population is high and the mortality rate is low.

Table 2. Result Estimation Natural Increase

Breeds	Variable	Year					Average (year)
		2024	2025	2026	2027	2028	
Saanen	Births relative to population (Head)	47	58	72	86	97	72
	Births relative to population (%)	41,96	42,65	42,86	44,56	44,70	43,34
	Deaths relative to population (ekor)	3	3	5	5	6	4
	Deaths relative to population (%)	2,68	2,21	2,98	2,59	2,76	2,64
	Natural increase (NI)	39,28	40,44	39,88	41,97	41,94	40,70
	NI Category	High	High	High	High	High	High
	12 Months NI for males (%)	19,22	20,22	19,94	20,99	21,19	20,31
	12 Months NI for females	20,06	20,22	19,94	20,99	20,75	20,39
Sapera	Births relative to population (Head)	20	24	30	34	39	29
	Births relative to population (%)	45,45	46,15	47,62	47,89	48,75	47,17
	Deaths relative to population (ekor)	2	1	2	2	3	2
	Deaths relative to population (%)	4,55	1,92	3,17	2,82	3,75	3,24
	Natural Increase (NI)	40,90	44,23	44,45	45,07	45,00	43,93
	NI Category	High	High	High	High	High	High
	12 Months NI for males (%)	20,45	22,12	22,23	22,54	23,08	22,08
	12 Months NI for females	20,45	22,12	22,23	22,54	21,92	21,85
Bligon	Births relative to population (Head)	62	76	92	108	123	92
	Births relative to population (%)	46,27	46,91	47,67	48,43	48,81	47,61
	Deaths relative to population (ekor)	3	5	6	6	9	6
	Deaths relative to population (%)	2,99	3,09	3,11	2,69	3,57	3,09
	Natural increase (NI)	43,38	43,82	44,56	45,74	45,24	44,52
	NI Category	High	High	High	High	High	High
	12 Months NI for males (%)	21,64	21,91	22,28	22,87	22,81	22,30
	12 Months NI for females	21,64	21,91	22,28	22,87	22,43	22,22

Net Replacement Rate

The Net Replacement Rate (NRR) calculation is useful to determine whether the number of livestock births can cover the need for replacement livestock so that the population remains constant (Sumadi, 2001). The formula for calculating the NRR is the availability of breeding stock divided by the need for replacement, then multiplied by 100%. Susanti et al. (2015) stated that the NRR is obtained from the number of young livestock comparisons of potential replacements divided by the need for replacement livestock per year, and multiplied by 100%. The results of the calculation of the NRR in this study (Table 3) show that the average for five years is 319.2% in male Saanen goats, 211.80% in female Saanen goats, 453.51% in male Sapera goats, 208.92% in female Sapera goats, and 517.01% in male Bligon goats, 209.68% in female Bligon goats. Based on these values, it can be interpreted that the UPTD BPPTDK of the Agriculture and Food Security Office of the Special Region of Yogyakarta can be categorized as feasible as a source of seeds because the NRR value of male and female goats is more than 100%.

Table 3. Result Estimation Net Replacement Rate

Breeds	Variable	Year					Average
		2024	2025	2026	2027	2028	
Saanen	Need for replacement males (%)	6,25	6,37	6,35	6,39	6,45	6,36
	Availability of males (%)	19,22	20,22	19,94	20,99	21,19	20,31
	Net replacement rate males (%)	**307,52**	**317,43**	**314,02**	**328,48**	**328,53**	**319,2**
	Need for replacement females (%)	9,23	9,56	9,52	9,84	9,98	9,62
	Availability of females (%)	20,06	20,22	19,94	20,99	20,75	20,39
	Net replacement rate females (%)	**217,33**	**211,51**	**209,38**	**213,24**	**207,85**	**211,80**
Sapera	Need for replacement males (%)	5,30	5,13	4,76	4,69	4,58	4,89
	Availability of males (%)	20,45	22,12	22,23	22,54	23,08	22,08
	Net replacement rate males (%)	**385,85**	**431,19**	**466,69**	**480,26**	**503,56**	**453,51**
	Need for replacement females (%)	9,98	10,26	10,58	10,80	10,83	10,49
	Availability of females (%)	20,45	22,12	22,23	22,54	21,92	21,85
	Net replacement rate females (%)	**207,85**	**215,59**	**210,05**	**208,77**	**202,34**	**208,92**
Bligon	Need for replacement males (%)	4,23	4,32	4,32	4,33	4,37	4,31
	Availability of males (%)	21,64	21,91	22,28	22,87	22,81	22,30
	Net replacement rate males (%)	**511,58**	**507,18**	**516,14**	**527,37**	**522,37**	**517,01**
	Need for replacement females (%)	10,20	20,49	10,71	10,76	10,85	10,60
	Availability of females (%)	21,64	21,91	22,28	22,87	22,43	22,22
	Net replacement rate females (%)	**212,16**	**208,87**	**208,09**	**212,48**	**206,79**	**209,68**

The average NRR of males for five years in the three goat breeds is higher than females. The NI average of male for five years in Saanen goats was 20.31%, Sapera 22.08%, and Bligon 22.30. The NI average of female for five years in Saanen goats was 20.39%, Sapera 21.85%, and Bligon 22.22%. This is because the replacement needs of males are lower than females, so although the male NI value does not differ much, namely an average of 1% with the female NI value, the male NRR is higher than the female NRR. The NRR value is related to the NI value because the amount of male NRR is the result of the division of male NI by male replacement needs. This is by the statement of Hardjosubroto (1994), which states that the amount of female NRR is the result of the division of female NI by female replacement needs.

Output

Based on the calculations (Table 4), the total output in five years is 339 Saanen, 138 Sapera, and 432 Bligon goats. The natural increase influences the output of goats because the natural increase represents the increase in livestock population in an area in one year, which can affect the output as the potential or ability of the area to release replacement stock and culled livestock. This is by the statement of Sumadi et al. (2001), who stated that the greater the natural increase value reflects the greater the output.

Table 4. Result Estimation Output

Breeds	Varible	Year				
		2024	2025	2026	2027	2028
Saanen	Culling Livestock					
	Male (Head)	6,25	8,66	10,67	12,33	14,00
	Male (%)	7,00	6,37	6,35	6,39	6,45
	Female (Head)	9,23	13,00	16,00	19,00	21,66
	Female (%)	10,33	9,56	9,52	9,84	9,98
	Remaining *replacement*					
	Male (Head)	12,97	18,84	22,83	28,18	31,99
	Female (%)	14,53	13,85	13,59	14,60	14,74
	Male (Head)	10,83	14,50	17,50	21,51	24,32
	Female (%)	12,13	10,66	10,42	11,15	11,21
	Output					
	Output (Head)	44	55	67	81	92
	Output (%)	39,28	40,44	39,88	41,98	42,38
	Total					**339**
Sapera	Culling Livestock					
	Male (Head)	2,33	22,67	3,00	3,33	3,67
	Male (%)	5,30	5,13	4,76	4,69	4,58
	Female (Head)	4,33	4,24	6,67	7,67	8,67
	Female (%)	9,85	10,26	10,58	10,80	10,83
	Remaining *replacement*					
	Male (Head)	6,66	8,83	11,00	12,67	14,80
	Female (%)	15,15	16,99	17,47	17,85	18,50
	Male (Head)	4,66	6,17	7,34	8,34	9,50
	Female (%)	10,60	11,86	11,65	11,74	12,25
	Output					
	Output (Head)	18	23	28	32	37
	Output (%)	40,90	44,24	44,46	45,08	46,16
	Total					**138**
Bligon	Culling Livestock					
	Male (Head)	5,67	7,00	8,33	9,66	11,00
	Male (%)	4,23	4,32	4,32	4,33	4,37
	Female (Head)	13,67	16,99	20,66	24,00	27,33
	Female (%)	10,20	10,49	10,71	10,76	10,85
	Remaining *replacement*					
	Male (Head)	23,33	28,50	34,67	41,34	46,48
	Female (%)	17,41	17,59	17,96	18,54	18,44
	Male (Head)	15,33	18,50	22,34	27,00	30,15
	Female (%)	11,44	11,42	11,57	12,11	11,96
	Output					
	Output (Head)	58	71	86	102	115
	Output (%)	43,28	43,82	44,56	45,74	46,62
	Total					**432**

The total output of Bligon goats (432 heads) over five years was higher than that of Saanen goats (339 heads) and Sapera goats (138 heads). This is due to the large number of female Bligon goats in the population (82 heads), with the highest kidding rate (123 heads). Factors affecting the output in an area are the pattern of livestock breeding in a population, including the mating system and the length of use of adult livestock calculated from the age limit of maintenance, age of first mating, natural increase, percentage of livestock mortality, percentage of adult livestock, and net replacement rate value. This is consistent with the statement by Sumadi et al. (2004), who explained that the mating system and duration of livestock utilization within a population significantly impact the output value of a region.

Livestock Sales Estimation

Goat selling prices at UPTD BPPTDK, under the Yogyakarta Agriculture and Food Security Office, are determined by local regulations, with classifications based on the goat's age, breed, and reproductive performance or breeding feasibility. The average price of goats in the UPTD BPPTDK Yogyakarta is shown in Table 5. The results presented in Table 5 indicate that goat prices vary according to age and breed. Performance can also be used as a determinant of livestock selling prices, such as body length and shoulder height. This supports the statement by Mirwandhono et al. (2019), which highlights that in goat trading, performance is often used as a reference for pricing, as weighing equipment is rarely available. Breed differences influence goat body size, and this directly impacts selling price, as larger-bodied breeds tend to have higher market values (Haki, 2019).

The number of outputs or livestock that can be released each year is based on the results of the population growth simulation presented in Table 1. The data in this study used to estimate the

sales of livestock outputs, which are then calculated as gross income for the UPTD BPPTDK from 2024 to 2028. Table 6 presents the estimated sales value of livestock outputs. Over five years, UPTD BPPTDK of the Yogyakarta Agriculture and Food Security Office generated a total of Rp. 2,738,350,000 from the sale of Saanen, Sapera, and Bligon goats. This value represents gross income because it has not been reduced by production cost components such as feed, labour, and other maintenance operations. Thus, the results of this estimation can provide an initial picture of the potential economic contribution of goat breeding activities in UPTD BPPTDK, as well as a basis for evaluating business feasibility and planning for further development.

Table 5. Livestock Price

Breeds	Variable (Age)	Sex	Average(Price)
Saanen	Weaning	Male	750.000
		Female	900.000
	<6 Months	Male	7.000.000
		Female	6.000.000
	<12 Months	Male	13.000.000
		Female	12.000.000
Sapera	Weaning	Male	750.000
		Female	900.000
	<6 Months	Male	2.700.000
		Female	1.700.000
	<12 Months	Male	8.000.000
		Female	5.250.000
Bligon	Weaning	Male	600.000
		Female	600.000
	<6 Months	Male	2.100.000
		Female	1.600.000
	<12 Months	Male	3.650.000
		Female	1.800.000

The results of the estimated livestock sales presented in Table 6, will later become the projected gross income of the UPTD BPPTDK and serve as indicator of its production capability, market strategies applied, and market demands. This aligns with the statement of Jufri et al. (2020), who stated that gross domestic and regional income is a key macroeconomic indicator used to assess economic performance in a region at the provincial district or city level, reflecting the condition and achievement of regional economic activity or performance.

Table 6. Result Livestock Sales Estimation

Breeds	Year	Sex	Livestock (Head)			Total (Head)	Price (Rp)			Total annual income /years (Rp)
			Weaning	6 Mth	12 Mth		Weaning	6 Months	12Months	
Saanen	2024	M	11	6	1	17	8.250.000	42.000.000	13.000.000	197.050.000
		F	2	2	10	15	1.800.000	12.000.000	120.000.000	
	2025	M	13	7	2	22	9.750.000	49.000.000	26.000.000	267.450.000
		F	3	2	14	19	2.700.000	12.000.000	168.000.000	
	2026	M	17	8	3	28	12.750.000	56.000.000	39.000.000	350.450.000
		F	3	4	18	25	2.700.000	24.000.000	216.000.000	
	2027	M	20	10	5	34	15.000.000	70.000.000	65.000.000	453.600.000
		F	4	4	23	31	3.600.000	24.000.000	276.000.000	
	2028	M	22	11	6	39	16.500.000	77.000.000	78.000.000	523.100.000
		F	4	4	27	35	3.600.000	24.000.000	324.000.000	
					Total	266			Total Per Periode	**1.791.650.000**
Sapera	2024	M	5	2	1	8	3.750.000	5.400.000	8.000.000	35.500.000
		F	1	1	3	5	900.000	1.700.000	15.750.000	
	2025	M	5	2	2	10	3.750.000	8.100.000	16.000.000	61.950.000
		F	1	1	6	8	900.000	1.700.000	31.500.000	
	2026	M	7	3	3	13	5.250.000	10.800.000	24.000.000	79.400.000
		F	1	1	7	9	900.000	1.700.000	36.750.000	
	2027	M	9	4	3	16	6.750.000	10.800.000	24.000.000	97.550.000
		F	2	1	10	13	1.800.000	1.700.000	52.500.000	
	2028	M	9	5	3	18	6.750.000	13.500.000	24.000.000	105.500.000
		F	2	1	11	14	1.800.000	1.700.000	57.750.000	
					Total	114			Total Per Periode	**379.900.000**
Bligon	2024	M	15	7	3	25	9.000.000	14.700.000	10.950.000	64.650.000
		F	3	3	13	18	18.000.000	4.800.000	23.400.000	
	2025	M	18	9	5	32	108.000.000	18.900.000	18.250.000	89.350.000
		F	4	3	19	26	24.000.000	4.800.000	34.200.000	
	2026	M	22	11	7	40	132.000.000	23.100.000	25.550.000	112.050.000
		F	4	4	23	31	24.000.000	6.400.000	41.400.000	
	2027	M	26	13	9	48	156.000.000	27.300.000	32.850.000	140.750.000
		F	5	5	30	40	3.000.000	8.000.000	54.000.000	
	2028	M	29	15	10	54	174.000.000	31.500.000	36.500.000	160.000.000
		F	6	5	35	46	36.000.000	8000.000	63.000.000	
						361				**566.800.000**

Conclusion

The results of the population simulation indicate that the number of goats at UPTD BPPTDK-DPKP DIY is projected to increase steadily over the next five years. The calculated Net Increase (NI) and Net Reproduction Rate (NRR) confirm that this unit is feasible to serve as a reliable source of breeding stock. Based on the technical parameters used, it is estimated that from 2024 to 2028, the projected number of goats available for distribution could generate a total gross income of approximately Rp 2,738,350,000.

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